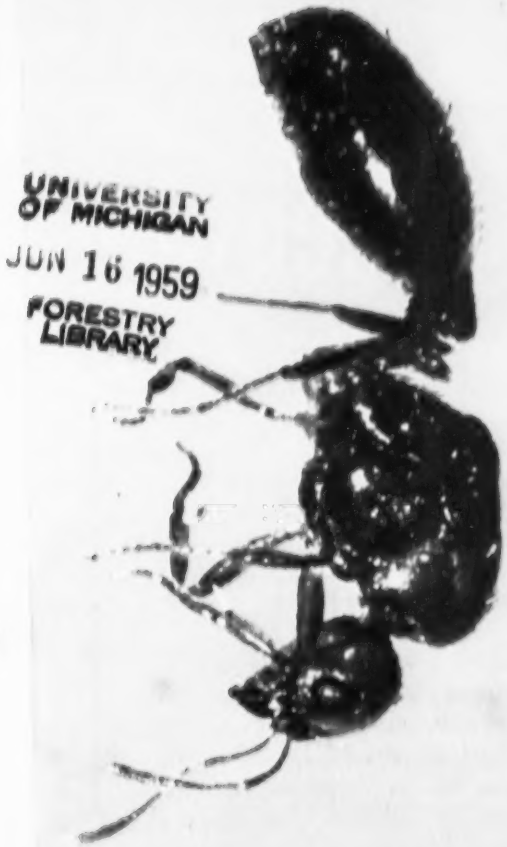
AGRICULTURAL Research

June 1959



U. S. Department of Agriculture

AGRICULTURAL
Research

Vol. 7—June 1959—No. 12

CONTENTS

Editor: J. F. Silbaugh. Managing Editor: J. R. Deatherage. Contributors to this issue: E. N. Cresci, E. Evers, M. S. Peter, P. K. Schultz, D. N. Mayberry, H. F. Lehnert, Jr

Golden era

New power to manage the molecule—even new insight into the nucleus of the atom—have come from man's recent basic explorations of the physical sciences.

Perhaps this golden era of the physical sciences will be followed by a golden era in the biological sciences. That's the promise of understanding the cell as a unit of life.

Such an achievement could rival anything that man has ever done. Agriculture, especially, would benefit. Learning to control the mechanisms and functions of living cells promises to help us breed more productive, higher quality crops and livestock . . . eradicate costly diseases and insects . . . maintain the quality of farm products during processing and marketing . . . and improve human nutrition.

But innumerable questions must first be answered:

For example, everyone knows that nutrient elements such as potassium pass readily from the soil into the plant. But no one knows why. You see, the elements are typically in solutions of low concentration in the soil and high concentration in the plant cell—which seems like water running up-hill.

Or take light. We know that it controls such growth processes as flowering, stem elongation, pigment formation, and tuberization. But how? We need to understand the chemistry of the active light-absorbing material in the cell.

And what makes one cell reproduce itself and eventually become a muscle, while other cells develop into nerves, fat, cartilage, or bone? Genes and cytoplasmic particles are probably important in both development and differentiation. What about the gene—is it the fundamental unit of heredity? There's now evidence that genes may consist of chemical subunits. Understanding the chemical organization, reproduction, and function of the fundamental units could lead to their modification by chemical treatment, and this suggests modifying the metabolic processes that take place in living cells.

You can see the implications of such mastery over biological behavior. Ability to produce specific desirable effects would open the way for phenomenal advances. Not only would agriculture benefit—so would all mankind.

Agricultural Research is published monthly by the Agricultural Research Service, United States Department of Agriculture, Washington 25, D.C. The printing of this publication has been approved by the Bureau of the Budget, August 15, 1958. Yearly subscription rate is $1 in the United States and countries of the Postal Union, $1.50 in other countries. Single copies are 15 cents each. Subscription orders should be sent to the Superintendent of Documents, Government Printing Office, Washington 25, D.C.

Outstanding performance and leadership by individuals, accomplishments and teamwork by units are cited in USDA's annual awards program. Achievements like this benefit people everywhere.

SALUTE FOR EXCELLENCE

■ OUTSTANDING ACHIEVEMENTS OF USDA personnel each year are recognized by Distinguished and Superior Service Awards. On May 26, 1959, Secretary Ezra Taft Benson so honored 111 employees and 19 work units.

ARS Distinguished Service Award winners:

H. A. BORTHWICK, *Crops Research Division*, for outstanding contributions to the present understanding of how light affects the biological behavior of plants and for leadership in field of photoperiodism.

W. B. VAN ARSDEL, *Western Utilization Research and Development Division*, for leadership, administrative ability, and scientific contributions to pioneering research on utilization of agricultural products.

ARS Superior Service Award winners:

Office of Administrator: F. A. TODD, for planning defenses against biological or radiological attack, and developing ways to cope with emergencies resulting from such attacks or from accidents.

Animal Disease Eradication Division: D. MILLER, for

TURN PAGE

W. B. VAN ARSDEL, international expert on vegetable dehydration, has extended frontiers of food processing science and technology.

H. A. BORTHWICK, chief scientist of Pioneering Research Laboratory in Plant Physiology, studies light effect on plants.

501966° 59

SALUTE FOR EXCELLENCE

(Continued)

unusual ability in administering disease prevention and eradication programs, and exceptional competence and ingenuity in performing his work.

Animal Husbandry Research Division: M. P. BRYANT, for research and leadership in bacteriological work that has given us basic information on the function of rumen bacteria in livestock nutrition.

J. W. THOMAS, for advancing basic knowledge of nutrition needs of growing dairy animals, and of feed requirements of dairy cows in production, which has resulted in more efficient feeding practices.

Crops Research Division: S. L. EMSWELLER, for research and leadership in cytology, genetics, and breeding of lilies and other ornamental plants, advancing scientific knowledge and enriching horticulture.

H. STEVENS, for coordinating oat and barley improvement research in 11 States, for research, and for cooperating with plant breeders in supplying material.

J. A. STEVENSON, for outstanding leadership in mycological studies, supervision of mycological and plant disease reporting research, and organization and administration of the National Fungus Collection.

D. STEWART, for developing superior disease-resistant sugar beet varieties and for leadership of a national cooperative sugar beet research program.

N. W. STUART, for research on physiological processes in ornamental plants in relation to successive environments, time, control of flowering and other behavior, yield and flower quality.

Eastern Utilization Research and Development Division: W. G. GORDON, for studies on chemistry of milk resulting in isolation of new proteins and determination of their amino acid composition.

PLANT STEROID ASSAY GROUP and PLANT STEROID INVESTIGATIONS GROUP, for large-scale assays of wild plants and studies on precursors of cortisone.

J. J. WILLAMAN, for directing research to develop industrial, food, and pharmaceutical uses for agricultural products.

Entomology Research Division: MARY J. EDMANDS, for proficiency in editing scientific manuscripts and in helping authors prepare research reports effectively.

J. K. HOLLOWAY, for successful control of the Klamath weed by parasites and for administrative direction of all phases of research on biological methods of controlling insect pests and noxious weeds.

H. L. PARKER, for contributions to our knowledge of the natural enemies of introduced pests of American agriculture, and for promotion of international good will through his scientific endeavor.

PESTICIDE CHEMICALS RESEARCH LABORATORIES and FRUIT AND VEGETABLE INSECTS RESEARCH BRANCH, for developing effective lures for use in Mediterranean fruit fly eradication campaign.

ERMA S. VANDERZANT, for basic research on nutritional requirements of cotton insects which will facilitate laboratory rearing for studies on their control.

Farm Economics Research Division: M. M. REGAN, for work on economic problems of land and water resource development, resulting in improved procedures and practices for evaluating resource projects.

Northern Utilization Research and Development Division: ADMINISTRATIVE MANAGEMENT TEAM, for providing services which enabled the scientific staff to perform research more efficiently and rapidly.

C. W. HESSELTINE, for contributions to mycology, including taxonomy, fundamental studies of fungi, and ARS collection of molds, yeasts, and fungi.

L. L. MCKINNEY, for studying chemical reactions of vegetable proteins, explaining the cause of toxicity of certain processed proteins, for developing a test for this toxicity, and for developing new commercial products.

Plant Pest Control Division: HALL SCALE ERADICATION PROGRAM, for eradicating Hall Scale, an incipient insect pest, from the United States.

JO ANN HASTINGS, for initiative and performance in developing an efficient system for financial records and budgetary controls.

Soil and Water Conservation Research Division: EROSION CONTROL RESEARCH UNIT, for improving and simplifying the selection of slope-land conservation practices and opening the way for a universal equation adjustable to local soil, rainfall, and other factors.

J. F. MULLINS, for designing, improving, and constructing specialized instruments and apparatus for chemical applications and study of irradiation.

L. A. RICHARDS, for contributing to understanding of physical forces in movement of soil water and of many interrelationships between soil and water.

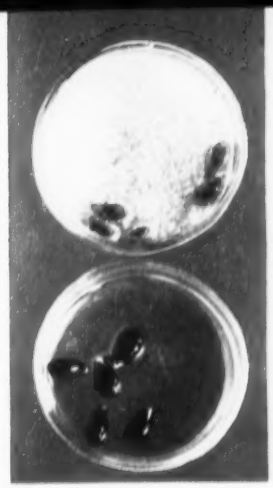
Southern Utilization Research and Development Division: J. J. BROWN and L. A. FIORI, for relating fiber fineness to cotton yarn quality which resulted in better products and greater processing efficiency.

MARY L. ROLLINS and V. W. TRIPP, for aids to textile processing through findings on cotton's microscopic and submicroscopic structure and behavior.

Western Utilization Research and Development Division: J. C. LEWIS, for accomplishments in fields of microbiology and biochemistry, especially in studies on amino acids, antibiotics, and vitamin B_{12}. ☆

SEEDS THAT NEED HELP

Test shows seed-lot quality range, due to needed planting conditions



DISEASE organisms thrived on leachings from partly deteriorated seed (top, above), but sound seed (bottom) didn't support disease. Vigor range in seedlings at left shows range in seed deterioration.

■ PARTLY DETERIORATED cottonseed may germinate well in the ideal environment of a standard laboratory test, but do poorly in the field. USDA research should help farmers get good emergence from these seed with hidden weaknesses by catering to the weaklings' more exacting needs.

Farmers usually plant much more cottonseed per acre than the tagged germination percentage calls for. They have learned the extra seed is good insurance against seedling diseases, damping-off, and other field hazards. Heavier planting rates also make up for weakling cottonseeds that fail to germinate or are easy prey to soil fungi and other disease organisms after emergence.

Farmers have no way of knowing at present how many of the viable seed are partly deteriorated and how well such seed will do under a wide variety of field conditions. ARS has developed a new laboratory test that evaluates hidden weaknesses in partly deteriorated seed by measuring germination percentage at a wide range of temperatures. With this information on the seed tag, farmers would know whether they have some weak seed that needs warm-weather seeding, rather than seed that will produce uniformly vigorous seedlings when conditions are just fair.

Warm storage weakens seedlings

With these weakling seeds in mind, plant pathologist J. T. Presley has developed a substitute for the less sensitive germination test. His new test is based on observations made while studying seed-quality changes that occur in storage. Temperature and moisture level determined how long seed would keep in good condition. For example, Presley found that seed kept at 100 percent humidity remained healthy for 25 days when stored at 36° F. or lower, but deteriorated rapidly within 15 days when stored at the high temperature of 104° F. Effect on seeds was checked by germination test. Germinated at various temperatures from moderate to low and moistures from optimum to excessive, seed kept too warm produced less-vigorous seedlings.

Not satisfied to know merely the result of storage conditions, Presley set out to learn what goes on in the seed as it deteriorates. He found that changes taking place within the cells of deteriorating seed alter its membranes and increase their permeability. Some soluble chemicals will leach out of all seed when placed in water, but at a much greater rate when membranes have been altered. Presley concluded that the degree of deterioration could be judged by measuring this leaching.

In testing for seed injury, Presley uses a sensitive electrical instrument called a conductivity bridge to measure the resistance to passage of electric current through water containing seed. The soluble chemicals leached from the seed act as electrolytes, easing the flow of current through the water. So the resistance difference between distilled water and water containing seed leachings is a measure of electrolytic content of the water. And readings made at time intervals measure the rate of leaching. Presley has demonstrated that rate of decline in resistance during a series of readings corresponds to degree of deterioration of the seed. The new technique may also distinguish dormant from dead seed.

Cottonseeds with high resistance ratings—that is, with little if any deterioration—are free of fungus growth when they are germinated. But the lower the resistance readings, the greater the growth of fungus and the earlier it appears. Presley concludes that the leachings may stimulate growth of fungi and give them an opportunity to spread to healthy seedlings from the same seed lot.

Findings are better, quicker

The new test not only enables us to predict cotton seedling vigor with increased accuracy, but also in less time—as little as 15 minutes, compared with several days for an ordinary laboratory germination test. Moreover, this test may be useful in testing viability of other seed. ☆

BETTER WEAPONS AGAINST THE FIRE ANT

Laboratory, plot, and field studies hasten the day when we will be rid of this troublesome pest

■ METHODS OF FIGHTING the imported fire ant continue to be improved through USDA research at Gulfport, Miss.

Findings at the ARS Methods Development Laboratory there should give us a better chance of getting rid of this pest, which has invaded nine southern States.

Chemists, entomologists, and plant-pest-control and equipment specialists at Gulfport are (1) developing better and more economical formulations and dosages of the insecticides now known to be effective against fire ants, (2) testing baits and attractants, (3) screening new chemicals, (4) improving application equipment and treatment methods, and (5) evaluating parasites, predators, and disease organisms as control aids.

The work is done in a modern chemical laboratory and greenhouse, along with about 400 plots of one-half to 3 acres each and over 2,000 acres in large fields.

Field tests were made in the past year with granular heptachlor and granular dieldrin, the insecticides used in the campaign. Heptachlor gave faster control. Time of application made no difference in ultimate results at rates being used. Studies with improved heptachlor formulations and laboratory-developed distributor attachments led to reducing rates from 2 to 1¼ pounds per acre.

Waterproofing of crystals is studied

Trial treatment of heptachlor granules with water repellents has also been promising. Insecticides are not now applied when plants are moist, because some of the material may occasionally stick to the plants and not reach the ground, where it is needed. Waterproofing would permit aerial application early in the morning, while dew is on the plants, rather than later when plants are dry but winds troublesome. This would extend the work day for pest-control workers.

Of numerous commercial insecticides evaluated so far, only three—heptachlor, dieldrin, and chlordane—now seem useful. Heptachlor is the one mainly used. Dieldrin is used to kill the imported fire ant only where the white-fringed beetle is also being eradicated.

Baits are sought as an economy measure

The scientists are making an intensive search for a bait to use against the imported fire ant. A good bait would permit use of still lower dosages of insecticides. The most promising materials found so far are vegetable oils, such as corn and peanut oils. None of the insecticide-bait combinations gave complete eradication in a single treatment at the insecticide rate used.

The equipment specialists have found that most aerial and ground application equipment must be modified to restrict flow rate without reducing uniformity of application. For example, specially designed metal vanes fitted to turbine blowers will limit swath width and obtain a uniform deposit of granules.

To accommodate the many farmers who mix insecticides in with their fertilizer to save an extra operation, the scientists are testing various such mixtures, hoping to find the best combination of these ingredients.

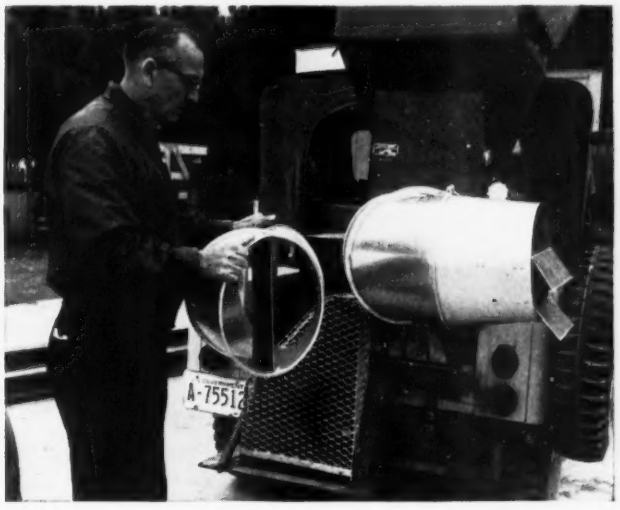
The laboratory cooperates with scientists on the fire ant in nine States—Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, and Texas—and with other Federal agencies. ☆

INSECTICIDE is applied by fertilizer distributor to one of 400 test plots at Gulfport laboratory, where chemicals are evaluated and best usage determined.

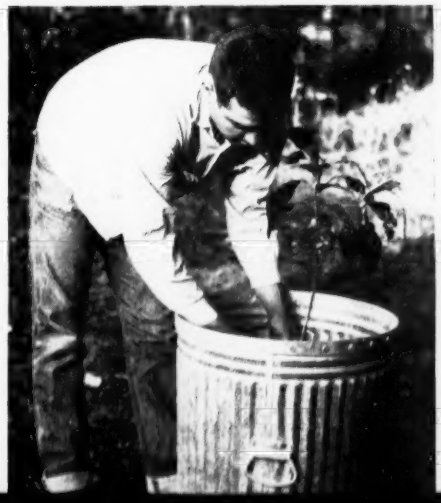
SOIL SAMPLE is taken from treated area to test for amount of insecticide remaining to destroy fire ants.

GRASS is also sampled and tested to find whether any insecticide adhered. All of chemical must reach ground, where it's needed.

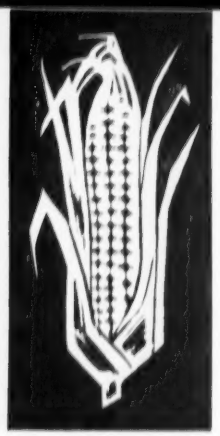
NOZZLE of turbine blower held by equipment specialist has vanes developed to give uniform deposit to granular insecticide.



NURSERY STOCK is dipped in insecticide to prevent the spread of ants from infested areas.



POISON BAIT in cartons is placed on ant mounds. The number of dead ants found in the colony 24 hours later indicates the effectiveness of bait under natural conditions.



TOP EAR of ordinary corn with about 25 percent amylose compares with new corns having 50 to 60 percent (center ear) and 70 to 75 percent amylose (bottom ear). Breeders are trying to develop productive high-amylose hybrids.

New amylose-rich hybrids from breeders and numerous research-proved industrial uses for this starch brighten the prospects for

CORN WITH A NEW INDUSTRIAL FU

■ AN INDUSTRIAL FUTURE for high-amylose starch—a new starch from a new corn—is predicted by USDA scientists. High-amylose corn would be a new raw material for the corn-refining industry, which normally uses 140 million bushels a year.

Chemists at the ARS Northern utilization division, Peoria, Ill., have demonstrated that amylose starch forms tough, durable films with many industrial packaging, wrapping, and coating possibilities. Federal, State, and private plant breeders have shown the feasibility of developing corn hybrids with a starch high in amylose content—perhaps as much as 100 percent of total starch.

A 16-year effort at Peoria to broaden the industrial market for corn has turned up these possibilities for amylose or its derivatives: transparent wrappers; water-soluble films for packaging measured amounts of such water-dispersible products as detergents, dyes, insecticides, medicines, and industrial chemicals; transparent, edible, and water-soluble films for wrapping foods such as quick-frozen meats and vegetables to be cooked without unwrapping; grease-resistant sausage casings, and coatings for special food-packaging papers; coating of high adhesive strength for paper; fiber binder in paper; permanent finish on fabrics; suspending agents in detergents; constituent in plastics and lacquers.

An obstacle to such commercial developments has been lack of an economic source of amylose. This difficulty is being attacked by plant breeders, who in 10 years have raised the amylose in experimental corn hybrids from 27 to over 80 percent of total starch. Their rapid progress has encouraged hope for corn with all-amylose starch. Reinforcing this hope is earlier success in developing hybrids having starch with 100 percent amylopectin, another starch of commercial importance.

Starch properties are studied

In 1953, commercial interests harvested several thousand bushels of corn with starch of 50 to 60 percent amylose. This provides, for the first time, enough high-amylose corn for industrial-scale milling and processing trials. Meanwhile, scientists are continuing studies of pilot-plant separation of starch from gluten and of chemical modifications of high-amylose starches to adapt them to the potential uses.

The Peoria scientists early recognized the potential of amylose as a raw material for films and fibers. They studied the physical, chemical, and mechanical characteristics of films made from amylose and from mixtures containing amylose, and measured the tensile strength, stretch, flexibility, and burst resistance of these films. These qualities increased with the content of amylose.

High amylose content is needed

The scientists also learned that amylose film is insoluble in water, but that its solubility can be modified by chemical means. They reasoned that amylose should be digestible because it is a component of ordinary starch. They measured the permeability of amylose films to water, to vapors, and to a variety of organic and inorganic chemicals. They established the fact that, for all-round industrial usefulness, amylose starch should contain no less than 80 percent (and ideally, 100 percent) amylose.

Natural high-amylose starch would eliminate the high cost of removing amylose from ordinary corn starch, which is about 25 percent amylose. So a search has been made for a natural plant source of high-amylose starch. Hundreds of samples of starch in corn, wheat, sorghum, root crops, and other crops, including inbred lines and crosses from both the U.S. and foreign countries, were tested at Peoria. By 1947, a study at Harvard University showed that certain combinations of genes could give corn containing starch with 65 percent amylose. Unfortunately, *total* starch content was very low.

In 1950, the Peoria staff, ARS

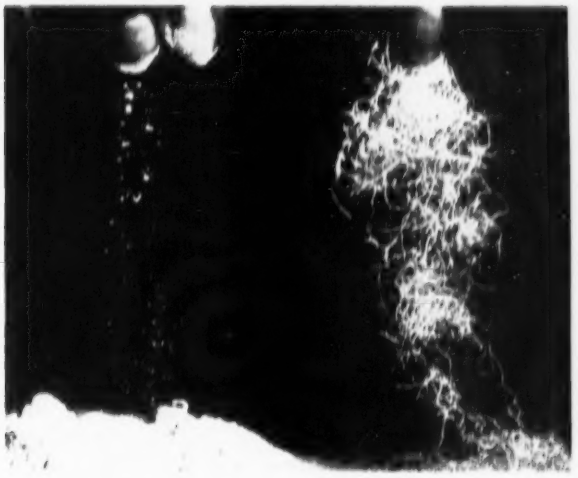
FUTURE

crops researchers, Missouri Agricultural Experiment Station, and Bear Hybrid Seed Company, of Decatur, Ill., initiated cooperative research to develop a high-amylose field corn. More than a thousand samples a year were examined for amylose content over several years. In 1952, the Bear Company reported discovery of a gene—usually referred to as *ae*—that substantially increased the amylose content of corn in which it appeared.

By 1954, breeders using gene *ae* had developed corn with 60 percent starch, of which 62 percent was amylose. Today, samples of corn with starch of more than 70 percent amylose are quite common, and a sample with more than 80 percent amylose was analyzed at Peoria in 1957. These corns, the work of the Missouri Station and the Bear Company, utilize a "modifier gene complex" that combines specifically with the *ae* gene to boost amylose above the normal *ae* level of 50 percent.

Series of corns are in prospect

Until recently, most scientists talked of a high-amylose *corn*. Now, they believe that breeding will lead to a series of high-amylose *corns*, with starch ranging from 50 percent amylose upward. Preliminary research indicates that various amylose-amylopectin mixtures may well find a wide range of industrial uses. ☆



CHEMICALLY treated amylose starch forms a stringy material (right) that can be spun into fibers or made into films. But when amylopectin starch is given chemical treatment, it forms a powdery substance (left) with no film or fibrous properties.

TRANSPARENT and edible film covering for food has been produced in ARS studies of potential industrial uses for high amylose corn. F. R. Senti of Peoria laboratory displays sheet of film alongside ears of new corn and new starch from which film was made.

LUXURIOUS fibers shown were made from amylose starch. A textile outlet for such fibers would expand corn refiners' operations and, in turn, open a new market for corn.

Seed Treatment Aids Sesame

■ SEED TREATMENTS along with crop rotation may improve stands of sesame—a new, rapidly developing oilseed crop for the United States.

Studies by USDA plant pathologist C. A. Thomas show seed treatments can result in a significant reduction of bacterial leaf spot, blight, damping-off, and other diseases.

Although sesame is one of the world's oldest oil and seed crops, little work has been done anywhere on the control of its diseases. In this country, poor stands caused by diseases are a major difficulty in the Southeastern States. Diseases are less troublesome in the Southwest.

Production of sesame for oil and seed is promising for farmers who operate under acreage restrictions of basic crops. Imports of this product—9 to 24 million pounds annually since World War II—account for about 90 percent of our consumption. Large quantities of whole seed are used by bakers and confectioners.

The combined oil and protein content of sesame seed is probably greater than in any other edible seed or nut. The average is near 50 percent oil and 25 percent protein.

In disease studies of sesame on naturally infested soil in a greenhouse, untreated seed gave a stand of only 0.8 percent, but seed from the same lot treated with protectants gave a 73 percent stand. That's a 90-fold increase. Seeds used in both cases were over 94 percent viable.

Results varied with concentration of protectant, but stands ran as high as 73 percent on seed treated with captan, 63 percent with thiram, and 52 percent with chloranil.

In field tests with seed more than 96 percent viable, the same chemicals gave stands of 34, 39, and 32 percent respectively, compared with a 5-percent stand with untreated seed.

One-fourth ounce of captan per bushel of seed was almost as effective as 2 ounces of the other chemicals. At present-day prices, material costs about 1 cent per acre. No toxicity to plants was observed at the most effective concentrations.

Volatile mercuries and several other treatments also were tested, but gave less effective control than captan, thiram, or chloranil.

In most cases, seed of the variety Kansas 10 represented the dehiscent varieties—those whose seed capsules burst open when dried. Seeds of Dulce sesame and the indehiscent variety Delco were also used. ☆

LAND CONTRACT WINS NEW FAVOR

■ FARMLAND SALES financed by *land contract*—a type of installment plan without a mortgage—are enjoying revived popularity, USDA surveys show.

Land contracts bypass any third party. Buyers deal directly with land owners, in effect borrowing from the owner-seller and repaying him by installments.

ARS farm economist N. J. Wall has found that about a fifth of all land transfers—farm and nonfarm alike—or a whopping third of all credit-financed transfers are made by land contracts today. Their use has about doubled since 1946, with marked gains in all regions except the South, where a vendor's lien is the traditional form of land sale financed by sellers. For farm sales alone, sellers financed 43 percent of the total, or more than combined loans by credit institutions including Federal Land Banks, in the year ended March 1, 1958. In 1956, sellers financed 37 percent of the total.

In today's rising farm real estate market, the land contract is one of several credit devices sustaining demand for land despite higher prices. According to Wall, rising land values usually tend to keep out many potential buyers with little cash or without credit for the usual mortgage type of financing.

The land contract has two-sided appeal.

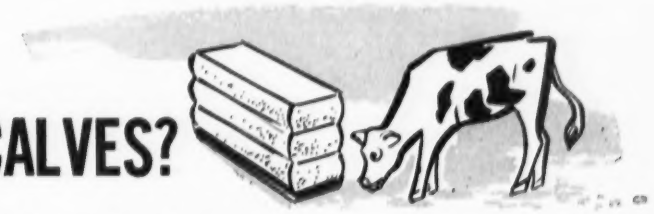
In the first place, a buyer gets control of a farm, generally for a relatively low down payment, and without waiting for a mortgage to be paid. Wall suggests that the easier installment terms may leave a buyer with cash to invest in farm stock and equipment. That's a big consideration for beginning farmers.

Secondly, an owner gains some tax advantages by selling his land on the installment plan. The total income

tax on this capital gain, spread over a number of years, may be considerably less than on a large amount received in a single year. To qualify for this tax saving, an owner must limit down payments under contract sale to 30 percent or less of the selling price.

Sellers may find land contracts have an additional advantage in the case of payment default. Repossession under the land contract is much faster than under conventional mortgage sales. Wall also cites some owners' preference for this method of realizing a steady return on their investment, rather than being faced with the problem of reinvesting a sizable lump sum.

Buyers have considerable advantage under land contracts, though they also assume some risk. The risk may not be too serious if contract payments are no greater than rent, but Wall emphasizes that a buyer's equity is jeopardized if the land contract is inflexible. For example, in some States, a buyer can lose his total equity for default of a single payment. These potential risks have not been too important recently, as land values have continued strong and farm income has been stable enough for most buyers to meet installments. ☆



Which ROUGHAGE for CALVES?

■ JUST WHAT COMBINATIONS of milk, grain, and roughage are most practical to raise a heifer from birth to calving at 2 years of age?

The latest in a series of long-range studies of this subject at USDA's Agricultural Research Center, Beltsville, Md., should help dairymen to determine what forages to feed—alfalfa hay, alfalfa silage, corn silage, or combinations of them.

It was found, for instance, that dairy heifers can be raised successfully to calving time on a ration limited to 370 pounds of whole milk and 400 to 500 pounds of grain, with all the good alfalfa hay they want.

Substituting wilted-alfalfa silage or a mixture of corn and wilted-alfalfa silage for the hay caused low feed consumption, low rates of gain, and lower weight at 2 years of age, according to ARS nutritionist J. W. Thomas, and physiologists J. F. Sykes and L. A. Moore. This doesn't mean, however, that hay-crop silages *shouldn't* be fed to replacement heifers. Supplemented with proper amounts of hay or grain, hay-crop silage will probably grow heifers equal in size to those fed hay as the only roughage.

Eighty-five calves were assigned in the Beltsville tests to five experimental groups at birth. Each calf got 370 pounds of whole milk from birth to 60 days, and a grain mixture from 10 to 240 days. Calves in one group got all the alfalfa hay they wanted. Those in other groups got all they wanted of a high-quality wilted-alfalfa silage alone or in addition to corn silage, hay, or varying amounts of grain. Animals were weighed monthly.

Here's what the scientists found:

In general, the body weight, rate of gain, and dry-matter consumption of heifers fed alfalfa hay was much higher than that of heifers fed unsupplemented alfalfa silage.

Supplements improve silage

Supplementing the silage with a pound of hay daily per hundred pounds of animal weight or with 2 pounds of grain daily produced heifers only *slightly* smaller than those given hay alone. Animals fed only silage ate less. Scientists are investigating the reasons.

The temporary disadvantage of feeding hay-crop silage as the sole or predominant feed for short periods can easily be overcome by adequate feeding at other times. Scientists say that heifers will grow normally if they get at least 4 pounds of grain daily in addition to all the hay-crop silage they want. In these tests, the wilted-alfalfa silage contained 30 percent dry matter. Silage with a higher moisture wouldn't give as good results.

Older calves still need grain

Growth rate and total dry matter intake were reduced in two of the groups when grain was taken away at 8 months of age, and severely reduced in Jerseys denied grain after 12 months.

The animals reared on hay or hay and silage produced a little more milk and butterfat during the first lactation than did those reared on silage alone. Production during subsequent lactations wasn't affected by the difference in growing ration. Differences in body weight after 2 years of age became less as the animals became older. And at 5, 6, and 7 years of age, there wasn't much difference in the weight of animals reared on silage and those on hay.

The effect that different roughages had on the calves' rate of gain was most pronounced from 8 to 12 months of age. So gain data for this period alone does not give a representative long-run picture. ☆

CONTROL for a CITRUS PEST

Encouraging new method of chemically treating irrigation water has controlled the destructive citrus nematode in test groves in the Southwest

■ THE CITRUS NEMATODE, which infests more than half the groves in Arizona, may no longer create its insidious and widespread damage.

This particular nematode has been successfully and economically controlled up to 2 years with only one application of a chemical metered into irrigation water. The treatment was even more effective when accompanied by pruning and hedging—that is, sawing off the sides of a tree with rotating saws mounted on hydraulic booms. This combination treatment resulted in better shoot growth, more uniform fruit, and better trees.

The citrus nematode is "ectoparasitic"—living only on the *outside* of the roots and feeding by puncturing the cortex of the root with its mouth parts. It is a different species from the burrowing nematode, which lives *inside* the roots and is associated with spreading-decline disease so destructive to citrus in Florida.

USDA nematologists H. W. Reynolds and J. H. O'Bannon, working with the Arizona Agricultural Experiment Station at Tempe, applied 2 to 10 gallons of DBCP (1,2-dibromo-3-chloropropane) per acre in three heavily infested groves. Control was good at 2 gallons per acre, nearly 100 percent at the higher levels. (Limited tests under different conditions with DBCP on the *burrowing* nematode in Florida are so far inconclusive.)

Excessive amounts of DBCP—much more than used in the tests—can be toxic to citrus, so that it may be necessary in practice to use light doses and repeat the treatments. Because one treatment gave such good control, however, the scientists feel that follow-up treatments won't be needed for at least 5 years, provided growers get *thorough* DBCP coverage the first time. This can be

SOIL SAMPLES from treated and untreated citrus groves are checked in laboratory by H. W. Reynolds for nematodes. Counts showed treatment was almost 100 percent effective.

GRAVITY-FLOW, constant-head metering device was successfully used to apply DBCP in irrigation water.

ENGINE-DRIVEN centrifugal pump was another device successfully used in applying DBCP through irrigation water. Metering of chemical was timed so that it was applied during the entire period of irrigation.

done if the soil is in good tilth and free of weeds, and the ground is level.

Pruning and hedging speed tree recovery

When the DBCP treatment was combined with hedging and pruning, the nematode-debilitated trees were rejuvenated and recovered much faster. Pruning without the DBCP treatment helps trees to recover, but only temporarily, since it has no effect on nematodes.

Chemicals were applied in several ways. In one method, an engine-driven centrifugal pump discharged the chemical and irrigation water into individually bordered rows during the irrigation. In another method, a mixture of water and emulsifiable DBCP was metered into the irrigation water in the rows through hoses from a 200-gallon tank. The emulsion was constantly agitated during application to insure complete mixing. Another method recently studied consists of metering the chemical directly into the irrigation water through a gravity-flow, constant-head metering device. The necessary mixing may be accomplished by introducing the chemical at a point of greatest water turbulence.

Soil and root samples were collected from treated and untreated plots and nematode counts were taken to test treatment effect. Nematodes were effectively controlled over the entire irrigated row, regardless of the distance from where the chemical was put into the water.

In experiments where DBCP-treated trees were only pruned, there were no outward signs of tree recovery from nematode injury by the end of the first growing season. Nor were there any outward signs of recovery where trees were treated with DBCP and not hedged and pruned. But trees hedged *and* pruned after DBCP treatment showed new and vigorous flushes of growth. Nematode counts were low, of course, wherever DBCP was applied, even without pruning and hedging.

Granted that the combination treatment works, the important question is—what will it cost?

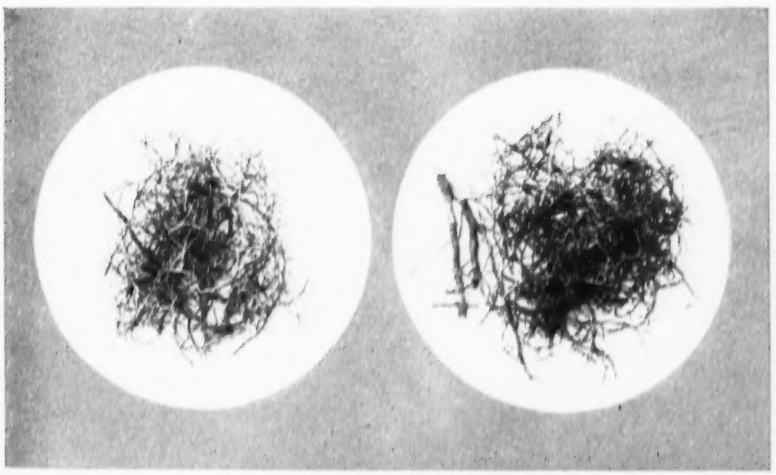
First, when you consider that citrus in Arizona is a $10 to $20 million business, it's easy to see that growers are willing to make more than just a short-range, casual investment.

Cost of treatment appears to be reasonable

Scientists estimate the cost of chemicals and hedging and pruning at about $78 per acre over a 5-year period, or about $16 per acre per year. This is a fair figure for renovating old groves, and considerably cheaper than pulling out old trees, fumigating the soil, and planting new trees that won't bear for several years.

Surveys underway in Arizona since 1948 checked on spread and damage by the citrus nematode. Since there are no prominent root symptoms, nematodes were unwittingly distributed with infected plants. Soil particles tend to cling to infected areas, making them look thicker than normal. Above-ground symptoms—usually not obvious until 3 to 5 years after infection—must be advanced to be noticed. Symptoms include yellowing of the leaves, and the typical signs of malnutrition—small leaves, small fruit, defoliated branch ends.

Surprisingly, the most seriously damaged trees have only small nematode populations. This is due to the fact that large numbers of nematodes feed on the roots, use up available nutrients, and then die off. ☆



NEMATODE-FREE citrus roots at left show normal, healthy appearance. Those at right are infected with citrus nematode, appear slightly thicker and darker due to adhering soil particles containing nematode eggs.

CONVERSATION over a backyard fence? No, just both ends of nematode looming up behind root. Odd looking object at left is egg mass in posterior of the worm.

Antibiotic—less scours

The big advantage of feeding aureomycin to dairy calves lies in its ability to reduce the incidence of scours (diarrhea), although it also brings about a temporary increase in growth rate, USDA scientists say.

In experiments at the ARS Agricultural Research Center, Beltsville, Md., test calves were fed aureomycin for 90 days after birth. Fewer of these calves developed scours than control animals that got none.

Differences between groups in the incidence of scours weren't large but were consistent for all ages and all periods during the tests. Three control calves died of diarrhea.

Calves fed the antibiotic gained an average of 19 pounds more than the control animals. But when the antibiotic was taken away, the aureomycin-fed calves gained less rapidly than the controls. At 6 to 12 months of age, there wasn't any significant difference between groups.

Aureomycin apparently stimulates the appetite and increases rate of gain and feed efficiency, but *only* while it's fed. These feeding advantages diminish as calves grow older. Adding aureomycin to the diet to speed up gain is seldom profitable after calves are 2 months old.

Table on fatty acids

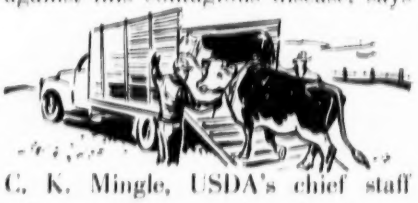
"Fatty Acids in Food Fats" is the title of a new, easy-to-use table prepared by USDA nutrition specialist Verz R. Goddard and statistical assistant Louise Goodall. It gives the amounts of palmitic, stearic, and total saturated fatty acids, and of oleic, linoleic, linolenic, and total unsaturated fatty acids in 72 food fats. Unsaponifiable matter and iodine value are also given.

The table, issued as Home Economics Research Report No. 7, has been designed for practical use by dietitians, nutritionists, home economists, and others planning and appraising diets. Single copies are available from the Office of Information, USDA, Washington 25, D.C.

Restrictions are eased

Certain restrictions on interstate movement of cattle from modified-certified brucellosis areas are being eased. This action, which will be of great value in the Federal-State campaign against brucellosis, has been endorsed by regulatory officials of 13 North Central States.

Lifting restrictions will step up participation of western cattle producers in the cooperative effort against this contagious disease, says



C. K. Mingle, USDA's chief staff officer for brucellosis eradication.

Most State officials favor free movement of cattle from modified-certified brucellosis areas. Such areas are certified when no more than 1 percent of all cattle nor more than 5 percent of all herds are infected. Certification is for 3 years.

Federal regulations already allow movement of cattle from certified areas. But some States require that breeding animals be blood-tested for brucellosis within 30 days to 12 months before shipment interstate. This often necessitates the added burden and expense of frequent blood testing for beef producers who also sell breeding stock interstate.

As a result, many beef producers postpone blood testing until just before shipping, and some western areas haven't achieved certification as quickly as they might have. Sixteen States, Puerto Rico, the Virgin Islands, and 833 counties in 30 other States have so far been certified. Massachusetts was the most recent State—the first in 1959.

State officials agreed that there should be no lowering of standards to establish and maintain certification. The officials also favored continuation of area certification for complete eradication of brucellosis.

They raise boll weevils

A synthetic boll-weevil diet developed in cooperative USDA-State research now enables scientists to raise enough weevils for laboratory testing. Increased supplies permit year-round screening of new materials and methods that may ultimately give better control of this cotton pest.

The diet's special feature is its source of protein—an acetone powder of cotton squares or bolls. Entomologists formerly could rear boll weevils only when cotton plants or parts were available to supply nutrition and stimulate egg-laying.

Aseptic techniques are not required for the synthetic diet. Mold inhibitors prevent microbe contamination, according to ARS entomologist N. W. Earle and co-workers who developed the diet at the Louisiana Agricultural Experiment Station. Their work grew out of pioneering research on diets with the pink bollworm and boll weevil conducted by Erma Vanderzant and coworkers of the Texas Agricultural Experiment Station.

Scientists can use the year-round supply of boll weevils in many ways

to advance the broad effort against the pest: testing effectiveness of insecticides, breeding weevil-resistant cotton, evaluating control by radioactive, mechanical, or pathological means. Our knowledge of the cost of boll-weevil control and of the insect's physiology, nutrition, and morphology can also be advanced.

Cotton for outdoor use

Cotton fabric can be given outstanding resistance to weathering and rot through a practical chemical treatment developed by USDA research.

The aim is to open new markets for cotton in awnings, tents, tarpaulins, and other outdoor fabric items.

The new treatment uses a water-soluble acid colloid of methylolmelamine, a chemical well known for its resin-forming qualities. Resins penetrate the outer portion of cotton fiber cell walls to become a part of the fiber rather than just a coating. ARS scientists, who developed the resin treatment, report that cotton impregnated in this way is virtually immune to rot and mildew.

Cotton's resistance to deterioration by sunshine is increased by the new treatment used in conjunction with certain fabric-coloring pigments, as shown in research by the Southern utilization division, New Orleans. The treatment can also be applied successfully to many vat-dyed fabrics.

Cost of the resin treatment is expected to be relatively low. Resins can be applied with conventional textile-finishing equipment.

Virus may be our ally

A disease that unexpectedly broke out among USDA laboratory collections of citrus red mite may well be effective in controlling the mite.

ARS entomologists Francis Munger, J. E. Gilmore, and W. S. Davis discovered the disease in the course of their studies of the biology of this mite at the Whittier, Calif., laboratory. The disease, believed to be caused by a virus, was found to be transmissible from sick and dead mites to healthy populations. It was also spread to healthy colonies by spraying them with water suspensions, prepared from ground-up diseased mites and passed through filter paper.

It takes from 7 to 13 days for the disease to become evident, depending probably on the concentration of inoculum introduced and the temperature. All stages of mites except the eggs appear to be susceptible.

The disease was first noted in mites collected from Oxnard. Originally thriving, one culture of mites was almost wiped out by the disease. It has since been found in a few localities in southern California.

There is still much to be learned about this disease and its value in control of mites, especially those that have developed resistance to miticides. Field trials are planned to find if new infections can be initiated in the field and whether mites can be effectively controlled with sprays containing the newly discovered pathogen. Studies are also planned to find out more about present distribution of the disease.

New seed-potato cutter

Slicing assorted sizes of seed potatoes into uniform seed pieces is fast and easy with an experimental cutter being developed by USDA.

One operator hand-feeding a commercial cutter based on this model can equal the output of four to five workers cutting tubers by hand. Tests show the machine can cut some 15,000 pieces an hour—about enough to plant an acre of potatoes, depending on row and seedpiece spacings. The cutter is now being tested in Minnesota by its designer, agricultural engineer G. W. French. The Red River Valley Potato Growers' Association (of Minnesota and North Dakota) is cooperating in the tests.

The promising new cutter has a rotary table fitted with positioning mechanisms for four potatoes. Potatoes are placed in two positioning mechanisms at a time. Turning the table 90° places the first potato under a plunger, which pushes the potato half way through a knife having three radiating blades. A rotating hori-

SEED-PIECE cutter is fed potatoes in two positioning mechanisms at a time.

UNITED STATES GOVERNMENT PRINTING OFFICE
DIVISION OF PUBLIC DOCUMENTS, WASHINGTON 25, D.C.

OFFICIAL BUSINESS

PENALTY FOR PRIVATE USE TO AVOID PAYMENT OF POSTAGE, $300 (GPO)

zontal knife halves the potato lengthwise, dropping the first three seed pieces to a conveyor. Rotating the table through another quarter-turn puts the remaining half potato under a second plunger that pushes the piece through a second vertical 3-bladed knife. Two positions on the rotary table are always open for feeding.

Conveyors carry seed potatoes to the operator and carry seed pieces from cutter to bags or bulk boxes.

What farm fires cost

Farm fires in 1958 destroyed about $156 million worth of livestock, machinery, crops, and buildings.

This was $4 million more than in 1957 and continued a trend since 1940. A factor in the rise, according to USDA economists, has been the increasing cost of replacing farm items destroyed by fire.

Farm-property value has increased, and farmers have added to their fire insurance somewhat in proportion to the rise in fire losses. Last year's fire losses rose 2½ percent but had a lighter impact on policy holders. The average loss rate—total fire cost related to total insurance—was 15.4 cents per $100 of fire insurance carried in 1958, compared with 15.9 cents in 1955. Loss rate has held consistently lower in recent years than in the 1940's and earlier. Fire and lightning insurance carried by about 1,700 farm mutual companies rose from $30.4 billion at the end of 1957 to $32.3 billion at the end of 1958—a 6-percent rise in 1 year. Some of this insurance covers windstorm damage and certain exceptional risks.

To cover heavy claims, farm mutuals had at last year end a surplus safety fund of about $200 million—62½ cents per $100 of insurance in force. Their operating expenses averaged 8.6 cents per $100 of insurance.

Claims paid for losses in 1958 due to fire, lightning, and exceptional causes were distributed as follows: 31 percent for fire and lightning, 17 percent for windstorm, and 2 percent for other forms of damage.

How much thiamine?

The amount of thiamine required by young teenage boys has now been established as a result of studies at the University of Illinois supported in part by funds from USDA.

Until recently, experimental data on requirements for boys this age have not been available. The National Research Council calculated its recommended Daily Allowance for thiamine on findings from experiments with adults and infants. Sub-

stantiation of these calculated results is especially important because teenage boys grow and develop rapidly and seem to have unusual requirements for food during adolescence.

The Illinois research showed that boys 14 to 17 years old required 1.41 milligrams daily of thiamine. This was about 0.38 mg. per 1000 calories eaten—a value within the range for people of other ages studied.

The boys were given a basal diet containing only 0.5 mg. of thiamine daily but completely adequate in all other nutrients. More thiamine was added as supplements in gradually increasing amounts so that at the end of 69 days the boys in the study were eating 2.7 mg. of thiamine daily.

Thiamine is carried by blood to tissues, which take up as much as they need or, when there is a deficiency, as much as is available. Any thiamine not used is excreted in urine. Thus researchers can tell from the amount excreted how well the thiamine intake is meeting body needs.

Leadership recognized

One of the Nation's oldest organizations devoted to the interests of farming—the Philadelphia Society for Promoting Agriculture—recently conferred its highest award for "outstanding leadership in the field of agricultural research" on ARS Administrator Byron T. Shaw.

The society, which dates back to 1785, consists of business and professional men with an interest in improving American agriculture. The organization was founded at the suggestion of Benjamin Franklin and numbered George Washington and Thomas Jefferson among its members.

U.S. GOVERNMENT PRINTING OFFICE: 1959